Polymeric Titanium Oxide Nano-Strands Photocatalytic Nano Coating Material For Building Protection & Environmental Applications

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<table>
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<th>“Outline of Presentation”</th>
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“Fostering Partnership For Sustainable Habitat”

The global community finds itself at a critical juncture today. We all recognize that succeeding in the attempts to mitigate climate change, control GHG emissions and combat various environmental issues is not down to one person. It’s about being resilient, with collaboration being the key ingredient that makes it all possible.

The 10th GRIHA Summit with the theme “fostering Partnership for Sustainable Habitat” shall serve as a platform to deliberate on inter dependence between organizations, systemic sustainability management, and feedback loops for better resource efficiency.
Existing Condition Of Health
Air pollution causes 1 in every 8 deaths in India: ICMR report ‘Deadlier Than Smoking In Causing Illness’

Sushmi.Dey@timesgroup.com

- 50% pollution deaths in under-70 age group
- In 2017, air pollution accounted for 12.4 lakh deaths in India, which included 6.7 lakh deaths due to outdoor particulate matter air pollution and 4.8 lakh deaths due to household air pollution
- In 2017, India witnessed 1.10 lakh premature deaths of children due to air pollution, highest in the world in the category of kids under five years of age.
WHY POLLUTION TAKES AWAY 10 YEARS OF YOUR LIFE

If you happen to live in Delhi, and pollution here were to come down drastically to levels WHO considers safe, then you could hope to add 10 years to your life. Overall, Indians could live for 4.3 years more. These were the findings of a global study by Michael Greenstone and Claire Qing Fan of the Energy Policy Institute at the University of Chicago. How did they come to these conclusions? And what does it mean for you?

POLLUTION WORSE THAN SMOKING
Pollution may up autism risk in kids

Study Says PM2.5 Makes Them 78% More Prone To ASD

Beijing:
Exposure to sources of outdoor pollution such as vehicle exhausts and industrial emissions can increase a child’s risk of developing autism spectrum disorder (ASD) by up to 78%, a study has warned. The research followed children in Shanghai from birth to three years to understand the effect of exposure to fine particles (PM2.5).

The study included 124 ASD children and 1,240 healthy children in stages over a nine-year period, examining the association between air pollution and ASD.

FIGHT FOR CLEAN AIR: In India and China, outdoor pollutants contribute to a high burden of disease and premature deaths
Air pollution can affect brain too, hit verbal and math skills: Study

MALATHY IYER & VINAMRATA BORWANKAR TNN

Mumbai:
Air pollution not only harms the heart and lungs, a new study indicates it affects the brain so much that people, especially the elderly, could struggle for words or to complete simple math.

Long-term exposure to air pollution severely affects cognitive skills, according to the joint study by Yale and Peking Universities and published in the reputed Proceedings of National Academy of Science (PNAS) journal.

“The PNAS study found significant reduction in verbal and math skills of people exposed to air pollution over a long duration,” said a release sent by the Washington based International Food Policy Research Institute that conducted the study along with Yale and Peking universities. “The effect was more pronounced among men than women—and worst among the elderly,” it added.

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**‘LONG EXPOSURE HARMS COGNITION, INCREASES DEMENTIA RISK’**

<table>
<thead>
<tr>
<th>Death By Air Pollution in India 2016</th>
<th>Risk factor</th>
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<tr>
<td>Ischemic heart disease</td>
<td>33.3%</td>
</tr>
<tr>
<td>Stroke</td>
<td>31%</td>
</tr>
<tr>
<td>Lower respiratory infection</td>
<td>51.5%</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>43.4%</td>
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<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>56.8%</td>
</tr>
<tr>
<td>Alzheimer &amp; other dementias</td>
<td>0%</td>
</tr>
</tbody>
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**THE KILLER LEVELS**
Three months ago, WHO Global Air pollution database said 14 of 15 most polluted cities in the world in terms on PM 2.5 concentration were in India.

<table>
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<tr>
<th>Safety limit for PM 2.5</th>
<th>WHO</th>
<th>10 μg/m3 (micrograms per cubic metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian safety limit</td>
<td>40 μg/m3 (Source: WHO and CPCB)</td>
<td></td>
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</table>

**Air Pollution in India**
- AQI breaches 300-mark during winter or festivals where people use crackers (Significant increase in respiratory problems).
- Carbon monoxide, PM 2.5 main pollutants in Mumbai; in Delhi, there’s PM2.5, PM10 and ozone.
- In winters, Delhi consistently records an AQI of above 300.

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"Conducted in China, where pollution levels are comparable to India.
Significant fall in verbal, math skills of people exposed to air pollution for long.
Effect more pronounced among men than women.
Worst among elderly."
“Air Pollution”

• Clean air is considered to be the basic requirement for human health and well-being. However, air pollution continues to pose a significant threat to human health worldwide.

• **Most harmful air pollutants are pm2.5, NOx, VOC, CO, SOx.**

• The increased public concern about the environmental pollution.

• The Present development of effective pollution removal technologies.

• Catalytic converters for automobile.

• In-house air purifiers/air filters.

• **Limitations**
WHAT NEXT??

Photocatalytic Oxidation Of Pollutants
“Photocatalytic TiO₂”

Photocatalytic TiO₂ (PCO or photocatalytic oxidation – the light activated reversal of photosynthesis) is a 45 year old technology that has been the subject of 9,000+ patents & 34,000+ scientific articles.

Widely studied for its potential to improve environmental remediation and infection control, there have been 30+ international conferences on the use of photocatalytic TiO₂ to treat air and water pollution. PCO products (self-cleaning glass, tile and aluminum cladding; smog reducing cement and paint; PCO air purifiers, etc.) generate nearly $2 billion of commercial activity a year – mostly in Europe and Asia.
“Photo-Catalytic Oxidation (PCO) Process”

------- WORKING OF TiO₂ PHOTOCATALYTIC MATERIAL -------

Generation of electron-hole pairs: \( \text{TiO}_2 + h\nu \rightarrow h^+ + e^- \)

The \( h^+ \) reacts with \( \text{OH}^- \) dissociated from water to form the hydroxyl radical.
\[ h^+ + \text{OH}^- \rightarrow \text{OH}^\cdot \]

The \( e^- \) reacts with molecular oxygen to form the superoxide anion.
\[ e^- + O_2 \rightarrow O_2^- \]

The superoxide anion further reacts with \( H^+ \) dissociated from water to produce \( \text{HO}_2^- \) radicals.
\[ H^+ + O_2^- \rightarrow \text{HO}_2^- \]

NO diffuses to the surface \( \text{TiO}_2 \) and is oxidized to \( \text{NO}_2 \) by \( \text{HO}_2^- \) radicals.
\[ \text{NO} + \text{HO}_2^- \rightarrow \text{NO}_2 + \text{OH}^\cdot \]

Finally, \( \text{NO}_2 \) reacts with hydroxyl radicals to form nitric acid.
\[ \text{NO}_2 + \text{OH}^\cdot \rightarrow \text{HNO}_3 \]

CB: Conduction Band  |  VB: Valence Band
Review

Solar photocatalysis: Materials, reactors, some commercial, and pre-industrialized applications. A comprehensive approach

Danilo Spasiano\textsuperscript{a}, Raffaele Marotta\textsuperscript{a,\ast}, Sixto Malato\textsuperscript{b}, Pilar Fernandez-Ibañez\textsuperscript{b}, Ilaria Di Somma\textsuperscript{c}

\textsuperscript{a} Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università degli Studi di Napoli “Federico II”, P.le V. Tecchio, 80, 80125, Napoli, Italy
\textsuperscript{b} Plataforma Solar de Almería-CEMAT, Carretera de Senés Km 4, 04200, Tabernas, Almería, Spain
\textsuperscript{c} Istituto di Ricerche sulla Combustione, Consiglio Nazionale delle Ricerche (CNR), P.le V. Tecchio, 80, 80125, Napoli, Italy

ABSTRACT

In the future, solar energy, along with other renewable resources, could play a key role in mass production of fine chemicals. It could also potentially solve environmental problems, as demonstrated by recent developments in the use of solar energy, such as solar photocatalysis. The solar photocatalytic technology has been demonstrated to be effective for:

- Treating groundwater, drinking water, industrial wastewater, and air and soil pollution,
- Water disinfection, and
- Industrial production of fine chemicals.
Construction of a photocatalytic de-polluting field site in the Leopold II tunnel in Brussels

E. Boonen a,*, V. Akylas b, F. Barmpas b, A. Boréave c, L. Bottalico d, M. Cazaunau e, H. Chen e, V. Daële e, T. De Marco d, J.F. Doussin f, C. Gaimoz f, M. Gallus g, C. George c, N. Grand f, B. Grosselin e, G.L. Guerrini h, H. Herrmann i, S. Ifang g, J. Kleffmann g, R. Kurtenbach g, M. Maille f, G. Manganelli d, A. Mellouki e, K. Miet f, F. Mothes i, N. Moussiopoulos b, L. Poulain i, R. Rabe i, P. Zapf f, A. Beeldens a

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c Université Lyon 1, CNRS, UMR5256, IRCELYON, Institut de Recherches sur la Catalyse et l’Environnement de Lyon, Villeurbanne, Lyon F 6962, France
d CTg Italcementi Group, Via Stezzano 87, 24126 Bergamo, Italy
e Institut de Combustion, Aérothermique, Réactivité et Environnement (ICARE), CNRS (UPR 3021)/OSUC, 1C Avenue de la Recherche Scientifique, Orléans, France
f LISA, UMR CNRS 7583, Université Paris Est Créteil et Université Paris Diderot, Institut Pierre Simon Laplace, Créteil, France
 g Physikalische Chemie /FBC, Bergische Universität Wuppertal (BUW), Gaußstr. 20, 42119 Wuppertal, Germany
h Italcementi Group, Via Stezzano 87, 24126 Bergamo, Italy
i Leibniz-Institut für Troposphärenforschung e.V. (TROPOS), Atmospheric Chemistry Dept., Permoserstraße 15, 04318 Leipzig, Germany
INTERNATIONAL SCENARIO
Airocide
Photocatalytic Air Purification System
Airocide® Photocatalytic Air Purification System; developed to oxidize all airborne organic matter, even those too small to be filtered. Airocide’s unique technology employs a reaction chamber packed with tiny silicone tubes encrusted with a highly reactive titanium dioxide catalyst. When energized by the system’s 253.7 nanometer UVG lamps, water molecules are split and surface-bound hydroxyl radicals are formed. Any organic matter, no matter how small, that contacts these HO- radicals is instantly destroyed. Airocide is listed by the FDA as a Class II medical device and has been shown by independent Air Quality Labs to be free of any ozone emission. The process results in only trace amounts of pure water vapor and CO₂. Airocide oxidizes mold spores, mycotoxins, bacteria, viruses, VOCs (gasses) and Ozone on contact. Proven on the International Space Station and Space Shuttle flights, Airocide is simply the one that NASA developed. Airocide works.
International Status

CRISTAL

KON CORPORATION

pureti

Italcementi Group

PHOTOCAT

"10th GRIHA SUMMIT"
Borgo Palazzo street – Bergamo, Italy
The project involved the requalification of about 500 m of Borgo Palazzo street in Bergamo, accounting for an active surface area of about 7,000 m² with grey paving stones for the roads and red ones for the sidewalks.

Umberto Tunnel – Rome, Italy

Dives in Misericordia Church – Rome

Hotel de Police – Bordeaux, France
La Cité de la Musique et des Beaux-Arts - Chambéry, France

Air France Headquarters
Roissy Charles de Gaulle International Airport
This NYC luxury building has the air-purifying power of 500 trees

By Sangeeta Singh-Kurtz May 7, 2018

Manhattan’s trendy west SoHo neighborhood just got an eco-friendly new addition with 570 Broome. From the outside, the 25-story building looks like a regular luxury condo. But it’s actually the first building in the US to boast a subtle but powerful enhancement that makes it good for the planet.

The facade is coated with a spray-on solution called Pureti. The treatment, which is water-based, provides 570 Broome with the purifying power of 500 trees—which is basically like taking 2,000 cars off the road for a year.

Pureti works by breaking down contaminants clogging Manhattan’s air via a photocatalytic process that transforms polluting particles into oxidizing agents. They’re then released into the atmosphere as harmless minerals. This process happens super fast—like millions-of-times-per-second fast—so that the surface is perpetually self-cleaning, minimizing operational costs for the building.
Fig. 1. Global market for photocatalyst products 2007–2014 ($ millions).
“OUR TECHNOLOGY”
Polymeric Titanium Oxide Nano-Strands with unusual properties

Chemical composition: 99.71% water, 0.29% solid Ti-Oxide : Water (Molar ratio) 1 : 1000
Viscous material & Soluble in water.
Viscosity: 8000-12000 cps
Zeta potential: -30 to -80 mV
Stability: Stable and reusable.
Photocatalyst: Very active in solarlight.
Pt Doped Titanium Nano Strands
Titanium Oxide Nano Strands

Pt/TiO$_2$

"10th GRIHA SUMMIT"
Adsorbent + Colored effluent → Color removal → Color decomposition & gel regeneration
TiO2 Nano Strand preparation scale up
TiO\textsubscript{2} Nano Strand Coating (TITANCAT)
Mold Formation On Natural Rock
Garden Rock After TiO$_2$ Coating
Anti-mold Application

Hydrophobic

"10th GRIHA SUMMIT"
Self Cleaning Mechanism
Self Cleaning Mechanism
Self Cleaning
Used Engine Oil Degradation
Oil Stain Degradation On Coated Surface
Photocatalytic degradation of atmospheric fine particulate matter (PM$_{2.5}$) collected on TiO$_2$ supporting quartz fibre filter

Kazuhiro Misawa, Yoshika Sekine, Yuki Kusukubo & Koki Sohara

Received 10 Apr 2018, Accepted 25 Sep 2018, Accepted author version posted online: 01 Oct 2018, Published online: 09 Oct 2018

ABSTRACT

Carbonaceous constituents in fine particulate matter (PM$_{2.5}$) are often associated with adverse health effects in humans. Although air filtration technology is widely used for preventing exposure to PM$_{2.5}$, the trapped PM$_{2.5}$ still has hazardous property if not treated subsequently. Thus, this study aimed to realise detoxification of PM$_{2.5}$ with a photocatalytic decomposition of carbonaceous compounds in PM$_{2.5}$ samples collected on a quartz fibre filter coated with titanium dioxide (TiO$_2$). The mass of PM$_{2.5}$ gradually decreased with time during the UV irradiation with a significant release of carbon dioxide (CO$_2$) as a product. The analysis of organic carbon (OC) and elemental carbon (EC) using a thermal/optical carbon analyser following the IMPROVE protocol showed that carbonaceous constituents such as OC1, OC2, OC3, OC4, and EC1 fractions were successfully decomposed by UV-irradiated TiO$_2$, whereas EC2 and EC4 fractions were inert to the photocatalysis. However, a majority of the carbon content, approximately 92% of the total carbon, was reduced by the proposed method. This shows that the photon-induced TiO$_2$ potentially reduces the hazardous effects of PM$_{2.5}$.
Figure 1. High-volume air samplers and typical PM$_{2.5}$ samples collected on TiO$_2$ filter.

Figure 2. SEM images of the quartz fibre filter before and after depositing TiO$_2$. 

![Graph showing OC concentration (µg/cm$^2$) over UV irradiation duration (day).]
Our Results of pm2.5
TEST REPORTS
Test composition:
1. CO 1200 ppm + C₃H₆ 1200 ppm + 40% O₂ + 40% CO₂. Sunlight exposure: 5 h
2. NO 936 ppm + 11% O₂ Sunlight exposure: 5 h
3. Toluene 2000 ppm (VOC)

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<th></th>
<th>CO</th>
<th>C₃H₆</th>
<th>NO</th>
<th>Toluene</th>
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<tbody>
<tr>
<td>CONVERSION</td>
<td>98%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
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<tr>
<td>DEGRADATION EFFICIENCY</td>
<td>3840 µg/m²/h</td>
<td>5700 µg/m²/h</td>
<td>3100 µg/m²/h</td>
<td>23000 µg/m²/h</td>
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</table>
Private Industry Air Purifier

VOC MONITORING WITH TIME

- Blue line: Without UV
- Red line: Without TiO2
- Green line: With TiO2

(a) Front View of Box
(b) View Port for taking readings
(c) Inside View of the Box displaying the position of lamp, ballast & VOC sensor controller

"10th GRIHA SUMMIT"
Controller General of Patents, Designs & Trade Marks
S.M. Road, Anand Baug, Mumbai - 400037
Tel No. (022) 24137700, 24141026 Fax No. 22413087
E-mail: mumbai-patent@nic.in
Web Site: www.ipindia.gov.in

Docket No 31054

To
DR. NITIN SHUKLA

NSA-85, NCL COLONY, NCL

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Total Amount: ₹ 0
Amount in Words: Rupees Only

Print
## TITANCAT BENEFITS

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<th>Applications</th>
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<tr>
<td>Air Purification</td>
<td>Residential Building</td>
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<tr>
<td>Smog Eating</td>
<td>Industrial Building</td>
</tr>
<tr>
<td>Deodorizing</td>
<td>Any Concrete Surface</td>
</tr>
<tr>
<td>Maintains The Aesthetics Of The Building Or Structure</td>
<td>Tunnels</td>
</tr>
<tr>
<td>Self Cleaning Property</td>
<td>Most Civil Structures</td>
</tr>
<tr>
<td>Super Hydrophilicity</td>
<td>UV Based Air Purifiers</td>
</tr>
<tr>
<td>Easy To Apply Coating</td>
<td>*TITANCAT Can Be Applied By Mechanical Spraying / Roller Brush</td>
</tr>
</tbody>
</table>

"CONCLUSION"
**COST ANALYSIS**

<table>
<thead>
<tr>
<th>COMPANIES</th>
<th>COST</th>
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<tbody>
<tr>
<td>GREEN EARTH NANO SCIENCE, CANADA</td>
<td>1750 US $ for 10ltrs (INR Rs.1,22,500)</td>
</tr>
<tr>
<td>PURETI, USA</td>
<td>Rs. 30,000 for 1 gallon</td>
</tr>
<tr>
<td>KON CORPORATION, JAPAN</td>
<td>Rs. 10,000 for 1 ltr</td>
</tr>
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**Our Technology : Affordable**
PROJECT: Los Angeles Community College District - Build Green

PROJECT SUMMARY: LACCD-BUILD Green is a $5.7 billion green building project that spans over 400 buildings on 9 separate college campuses in Los Angeles. The goal of LACCD-BUILD Green is to modernizing its colleges while protecting the environment and improving the quality of life for its 250,000 students, teachers and affiliates.

COST: $0.70 per sq. ft. fully applied.

“We went with an innovative titanium dioxide coating that wards off dirt and pollution, removing organic pollutants from the air and reversing the effects of greenhouse gases. It proved a major success and will cut our maintenance costs for years to come.” — Executive Director, Larry Eisenberg. LACCD-BUILD Green
• Getting affiliation from GRIHA and other green building organization.
• Development of Air Purifier Devices for Domestic, Industrial & Public Places.
• We are proposing this technology at an affordable cost.
Thanks

For further queries please fell free to contact me on:
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